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Comparison of calcium phosphate and zinc oxide nanoparticles as dermal penetration enhancers for albumin

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Abstract

Dermal drug delivery is highly preferred by patients due to its several advantages. Protein therapeutics have attracted huge attention recently. Since dermal delivery of proteins encounter problems, in this investigation, zinc oxide nanoparticles and calcium phosphate nanoparticles

were compared as enhancers for dermal permeation of albumin. Albumin was applied simultaneously with zinc oxide nanoparticles or calcium phosphate nanoparticles on pieces of mouse skin. Skin permeation of albumin over time was determined using a diffusion cell. Skin distribution of the nanoparticles and albumin over time was determined by optical and fluorescence microscopy. Zinc oxide nanoparticles and calcium phosphate nanoparticles acted as enhancers for skin permeation of albumin. Cumulative permeated albumin in presence of zinc oxide nanoparticles after 0, 0.5, 1, 1.5 and 2 h, were 0±0, 11.7±3.3, 21.1±3.5, 40.2±3.6 and 40.2±3.6 mg, respectively and in presence of calcium phosphate nanoparticles were 0±0, 20.9±7.4, 33.8±5.5, 33.8±3.7 and 33.8±3.7 mg, respectively. After 0.5 h, little amount of albumin was permeated in presence of every kind of the nanoparticles. After 0.5 or 1 h, the permeated albumin in presence of calcium phosphate nanoparticles was more than that in presence of zinc oxide nanoparticles and after 1.5 h the permeated albumin in presence of zinc oxide nanoparticles was more than that in presence of calcium phosphate nanoparticles. Images of skin distribution of the two nanoparticles over time, were somewhat different and distribution of albumin correlated with the distribution of the nanoparticles alone. The profiles of albumin permeation (in presence of each of the nanoparticles) versus time was delayed and linear for both nanoparticles while the slope for calcium phosphate nanoparticles was higher than zinc oxide nanoparticles. The enhancer effect of zinc oxide nanoparticles was stronger while the enhancer effect of calcium phosphate nanoparticles was quicker. Maximum cumulative (total) permeated albumin in presence of zinc oxide nanoparticles was obtained at time of 1.5 h, which was 40.2±3.6 mg, while in presence of calcium phosphate nanoparticles, it was obtained at 1 h, which was 33.8±5.5 mg. Skin distribution of the nanoparticles and albumin confirmed the above profiles.

Keywords: Albumin, calcium phosphate nanoparticles, zinc oxide nanoparticles, skin permeation, skin distribution, enhancer

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